

The authors assumed that the populations are all "rainbows," but on page 47 they mention the faint yellowish "cutthroat" mark of the trout from the Rio Yaqui in Sonora, Mexico, which de Buen in 1947 classified as Rio Grande cutthroats. Again on page 51 they say of the trout they style the Mexican golden trout, "These are beautiful fish and their dominant feature, when alive, is the bright orange 'cutthroat' color below the jaw and on the belly."

It is well known that cutthroats often have the colored lateral band and I have observed the "strong orange of the lower fins" (page 57) and the rosy color which they quote from Flechsig's field notes, "orange-red of ventrum does not extend up above lower bases of the paired fins. Rosy color is well developed between the parr marks," on cutthroats but never on rainbows. This exemplifies the difficulty of working with old preserved material when the principal identifying character is a genetic color pattern. This is also evident from the authors' color descriptions as "badly faded," page 59; the Rio Culiacán collection "closely resemble the Sinaloa rainbows after preservation," page 57; "these 8 specimens have faded to a dull brown . . . the rainbow stripe has completely disappeared," page 36.

A few contradictions are curious. On page 45 the authors (after not worrying about the underjaw "cutthroat" coloring) are upset by finding one specimen (out of 25) in the Santo Domingo River, Baja California, with three well-developed basibranchial teeth. They say, ". . . it gave no hint of other cutthroat characteristics. Hybridization with sea-run cutthroat could have occurred earlier, and this fish could represent the result of a rare recombination of genes or a gene mutation suddenly producing this character." After calling the Rio Yaqui trout "rainbows" on page 47, they state on page 64 that, "The possession of a faint, yellowish 'cutthroat' mark by the Black Canyon and Casas Grandes rainbows could reflect hybridization with the Rio Grande cutthroat . . ."

On page 59 the authors conclude that Stilwell was misinformed concerning the planting of hatchery rainbows in the Rio Truchas, but on page 64 the authors say, "If it is true, as Stilwell (1948, p. 135) states, that English immigrants introduced rainbow trout into northwestern Mexico, the Black Canyon and Casas Grandes populations could represent hybrids not only between the Rio Grande cutthroat, but also between the Gila trout or some other form of rainbow."

The "coefficient of difference" used by the authors is a "cookbook" method devised to replace standard statistical procedures. According to this method the vertebral counts of localities are compared (p. 34) in which even the extreme ranges of the counts do not overlap and yet they cannot decide whether or not the two populations overlap!

The authors prefer to ignore the present nomenclatorial procedure of dropping the extra i in the genitive case of proper names denoting species.

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**HANDBOOK OF COMPUTATIONS FOR BIOLOGICAL STATISTICS OF FISH POPULATIONS.** By William E. Ricker. Fisheries Research Board of Canada, Bulletin No. 119. The Queen's Printer, Ottawa. 1958. 300 pp., 44 figs. \$5.00.

This is a revised and greatly enlarged outgrowth of the author's earlier work, *Methods of Estimating Vital Statistics of Fish Populations* (1948), affectionately known by fishery workers everywhere as "The Green Monster." The revision presents a wealth of measurement theory and technique, the enormity of which defies comprehensive review. Compiled by one of the world's leaders in the field of population dynamics, the contents touch upon all problems commonly encountered in estimating fish population parameters. A wide variety of worked examples using hypothetical and actual data facilitates the application and solution of formulas derived by the author or drawn from a vast but scattered literature. Sources of estimation bias are recognized and, where possible, accounted for through appropriate data adjustment.

This is not a textbook, but strictly a handbook as the title indicates, and it will prove most useful to the more advanced student or researcher. The user must be familiar with the vagaries of natural populations, the intricacies of sampling theory, and the nature of variability. A working knowledge of the structure of modern fishing theory is also implied. Such previous understanding is indeed a formidable barrier to most biologists and the lack of it is frequently circumvented through acceptance at face value of measurement techniques that may not be appropriate in given situations. Unfortunately, the author did not devote more space to developing, in elementary terms, the theory referred to above. For the average biologist this would have meant enhancement of the book's over-all value and, conceivably, curtailment of indiscriminate "cookbook" application of techniques. Instead, the author plunges abruptly into a glossary of complex terms and symbols, many of which have been shown to have highly ambiguous meanings. [Note: An attempt to standardize terms and symbols has been made by the Conseil Permanent International pour l'Exploration de la Mer (1959).] Following a rather brief discussion of parameters (i.e., mortality, growth, and reproduction), he then considers in relatively great detail the interpretation and use of "catch curves" in estimating survival, and hence total mortality, in defined populations. Much of this discussion relies upon hypothetical examples in which certain factors, particularly recruitment, are either fixed or allowed to vary. This conditional approach illustrates what theoretically happens in nature; but is of little aid to the biologist struggling to estimate, say, actual recruitment, and hence recruitment-yield-stock relationships. The point here is that too much emphasis is frequently placed on the hypothetical mechanics of accepted and well-documented theory, and not enough on the real problems of establishing the conditions necessary to implement the theory and, just as important, of acquiring the data for computing the statistics it is designed to yield.

Chapters on mark-recovery experiments; uses of catch statistics to assess populations and various characteristics thereof; yield prediction; stock-progeny relationships; and the concept of equilibrium yield complete the handbook. Those describing

the purpose, structure, and application of marking experiments are particularly well done and should receive considerable attention from fishery biologists everywhere. The section on stock-recruitment relationships is greatly augmented by the author's own important contributions in this area. A very comprehensive bibliography and useful index supplement the text.

Seemingly glossed over throughout the book is consideration of the real adequacy of various types of fishing gear as sampling devices. In this connection one must acknowledge the important concept of "effective fishing intensity" advanced by Beverton and Holt (*On the Dynamics of Exploited Fish Populations* (1957)). They have shown through spatial and temporal stratification of fishing effort that a true probability-of-capture index can be derived for bottom-dwelling species taken by trawls. But this should not divert our attention from the fact that the effectiveness of other gears such as traps, gill nets, long lines, etc., depends almost entirely on the fluctuating availability of the species they are designed to capture. Population statistics based on catch and effort data issuing from fisheries employing such gear thereby suffer from bias of unknown degree.

In addition to presenting a concise summary of available techniques for studying fish populations, this handbook also alludes to many areas of fishery science in which knowledge is weak or lacking. In a sense, it could be considered a stimulus to further research in the field of population dynamics. A bargain at twice the cost, it will prove indispensable to many practicing biologists.

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**ON THE DYNAMICS OF EXPLOITED FISH POPULATIONS.** By R. J. H. Beverton and S. J. Holt. (Great Britain Ministry of Agriculture, Fisheries and Food. Fishery Investigations, Series II, Volume 19). London. 1957. 533 pp., figs., tables. £6 6s.

To say that this is a monumental work and is destined to become a classic in its field may sound trite, but in my opinion is a simple statement of fact. No treatise, on this subject, of comparable scale existed previously or is likely to be forthcoming for some years. I was privileged to hear parts of the formulations ably presented by the senior author in a special course of the Duke University Marine Laboratory at Beaufort, North Carolina, in the summer of 1951. The completed volume reflects the same thoroughness of analysis and care in presentation that was evident during the course. It represents the fruits of 6 years' work on the part of the authors, both internationally distinguished as biologists and biometricians. The analyses are directed primarily toward demersal fish and fisheries of the North Sea, but will inevitably be of much wider application in other fisheries and to other groups of animals as well.

The reader will find the arrangement of the material both orderly and logical. Part I introduces the concepts of factors contributing to the increase or

decrease of fish populations. This is followed by the presentation of mathematical models which take into account the four major influences on population size: recruitment, growth, natural mortality, and fishing mortality. These models are "deterministic" in that they assign constant values to population parameters. Although "probabilistic" models (with statistical variation in parameters) would be closer to nature, the authors have concluded (and I believe rightly so) that these models would not justify the great labor involved and the further complication of an already complex set of formulae, in consideration of the limitations of the basic data. The section concludes with formulae for estimation of the all-important yield, and other parameters such as catch-per-unit-effort, population number, mean length, and mean weight. Notable in this section is the use of the growth formula of von Bertalanffy, which the authors believe to have a much sounder physiological basis than the empirical curves used in previous treatments.

The problem of variation in the four basic parameters is considered in Part II. Here these rates are related to age, time, and population density. The further complexities introduced by fisheries depending on mixed populations of two or more species are also analyzed.

Estimation of the vital rates and other numerical values included in the mathematical models is set forth in Part III. Illustrative material is drawn mainly from the plaice and haddock fisheries of the North Sea, although other species and areas are mentioned. Total mortality rate and maximum age are derived, after which the problem of separating natural and fishing mortalities is faced. Methods of this separation from either marking experiments or age composition data are amply described. Methods of deriving recruitment and growth rates complete this section of the book.

A most salient feature, from the standpoint of the fishery administrator, is found in Part IV, which shows in detail how to apply the formulations to problems of regulation. Even an example of a work sheet for the calculations is provided. Calculations result in the yield curves and "yield isopleths." There is an extended exposition of certain principles and methods of fishery regulation, which, although slanted toward trawl fisheries, have a much wider application. Novelties, as compared with most studies of this type, are the consideration of economic as well as biological relationships, and the proposal of control charts to evaluate the effects of regulations. In the final pages this section becomes rather specific to North Sea problems, showing the effect of several fisheries working on the same resource, and venturing a prediction of the benefits to be achieved by the adoption of specific regulations.

To complete the book, the authors have added appendices containing tables of data used in application of the models, an extensive bibliography, and a useful glossary of symbols and subject index.

The reviewer had difficulty finding anything in this excellent book to criticize. However, for many present-day fishery workers the very thoroughness and complexity of the formulations, which provide one of the strengths of the treatment, also may contain one of its weaknesses. Men responsible for fishery administration are often not highly trained mathe-